ABSTRACT

Modern industries often face the risks associated with the use of toxic gases and radioactive substances, which can pose serious health and safety hazards, including organ damage from radiation exposure, as well as risks of fire, explosion, poisoning, and irritation. Existing risk control efforts include technical and administrative controls, the use of Personal Protective Equipment (PPE), training, and the implementation of monitoring technologies, but each still has shortcomings.

This research proposes the use of robots, specifically Unmanned Aerial Vehicles (UAVs) and Unmanned Ground Vehicles (UGVs) simultaneously, as an innovative solution for measuring and mapping gas distribution. By integrating the appropriate sensors for the detected objects, the cooperation between these two types of robots offers flexibility and safety in gas detection. Furthermore, this collaboration also enhances efficiency through fully automated operations and the division of measurement areas.

From the simulation results of various robot combinations (UGV-UGV, UAV-UAV, UAV-UGV) to select the combination to be used, the UAV-UGV combination was chosen due to the UAV's ability to effectively overcome obstacles, covering the shortcomings of the UGV, and the UGV with its larger battery capacity compensating for the UAV's limitations. By leveraging the advantages of both types of robots, this combination demonstrated the highest accuracy, at 83.48%, in measuring virtual gas distribution. This research also involved testing several movement scenarios to determine the most effective gas mapping strategy.

Keywords: *Gas Detection, Gas Mapping, Industrial Robotics, Automation, Unmanned Aerial Vehicle (UAV), Unmanned Ground Vehicle (UGV)*